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An Economic Analysis of Oases Environmental Deterioration in Xinjiang Autonomous Region of China

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新疆は豊富な農業と鉱山資源を持ち、中国においても綿花、食料、それに石油資源の一大供給基地となっている。しかし広大の新疆自治区は気候が乾燥のため、人間活動の殆どが天然、或いは人工アオシスに集中しているが、そのアオシスの生態環境は人口増加と過度の農業開発などにより、全体的に悪化しつつづけている。

本論文は、新疆自治区における自然条件とアオシスの生態悪化の現状を概観し、環境悪化をもたらした自然的・経済的・制度的な要因を分析したい。

1. Introduction

Located in Northwestern arid inland of China, Xinjiang is very rich in the natural resources of agriculture, energy and mines, and is regarded as Chinese resources supplying base for the further economic development. In a macro view, however, the oases environment in Xinjiang has been severely deteriorated, resulting from the insufficient understanding on the self-organization and self-adjustment mechanism of the oasis environment, and the relation between the arid climate and agricultural development. Therefore, it is very important to study the oases environment issues so as to optimize land use and sustain the economic development.

2. Present Status of the Oases in Xinjiang

The issues of arid land and oases are concerned worldwide. There are about 47.73 million km² of arid/half-arid land in the world, near 32.1% of the total world land area, in which China shares 47% or 4.55 million km²(Qian Yun, 1999). While in Xinjiang there are 1.21 million km² of arid land, accounting for 73% of its area or one eighth of Chinese territory, consisting mainly of Gobi, desert or desertification land. Distributed in the arid areas, there are thousands of oases, widely ranging from several *ha* to more than ten thousand *ha*, within which only about 200 oases have more than 1333 *ha*. As we know, each oasis in Xinjiang is an independent economic unit. Totally, the population density of Xinjiang is not more than 12/km², far less than the average level (119/ km²) of China, while for the population density of the oases, it becomes 288/ km², more than twice of China's average level, or near the level of eastern provinces.

Many of the oases in Xinjiang are man-made based on the natural oases. Since the establishment of P.R. China in 1949, quite a number of man-made oases had been reclaimed from the desert and Gobi areas such as Kashi Oasis, Aksu Oasis and Hotan Oasis in Tarim Basin, which nowadays have become big production areas of foods, cotton, sugar and edible oils in China. The area of man-made oases shares about 45% of the total oases area, and is still increasing now(see Table 1).

Table 1 Area Changes in Man-made Oases of XinJiang (km²)

	1949	1998	Annual growth	Increased folds
Whole XinJiang	20535	61905	876	3.01
North Xinjiang	6254	30635	348	2.63
East Xinjiang	1112	3176	43	2.86
South Xinjiang	13135	28094	312	2.14

Resource: Han Delin, ed., *Artificial Oasis in Xinjiang*, China Environment Science Press, 2001, p.24-25.

3. The Development History of Oasis Agriculture

The development of Oasis Agriculture in Xinjiang has experienced three periods, named as primitive period, modern period and contemporary period.

Primitive Period before 1912. It is a stage of adaptation. In order to survive, the ancient nomad would inhabit in the oases, the area with water, to conduct the primitive agriculture. Human activities in Xinjiang can be traced back to six or seven thousand years ago. And the ancient remains in Southern Xinjiang, showed more than two thousand years the agriculture was its main economic activities in Tarim Basin, the Hinderland of Taxorgan Desert, Barkol, Hami, Turpan as well as the drainage areas of Ili River. However, large-scale agricultural Production could be seen in Chin and Han Dynasties. Xihan Dynasty initiated the troops-station to reclaim the wasteland in Luntai (a policy pursued by feudal rulers since the Han Dynasty). After twice large-scale reclamation in Xihan and Tang Dynasties, early Qing Dynasty also experienced a third climax of rapid development of oasis agriculture, such as in Aksu Oasis, Kashi Oasis and Hotan Oasis.

Premodern Period of Oasis Agricultural Development (1912-1948).

In this stage, Xinjiang had experienced two periods of rapid development of Oases agriculture, from 1912 to 1928 and from 1933 to 1944, respectively developed 98 thousand ha and 270.3 thousand ha.

Contemporary Period of Oasis Agricultural Development (1948-present).

Over the past 50 years, Xinjiang has achieved much in the land development though it was a zigzag road.

In 1950s, in response to Central Government's call of garrisoning the national boundary and reclaiming the wasteland, the Xinjiang Production and Construction Corps was founded. Millions of youths from other parts of China, cooperated by the local ethnic inhabitants, devoted themselves in reclaiming the alkaline land, marshland and sandpit of the downstream areas as well as the deserted Gobi land. Hundreds of man-made Oases appeared around Tianshan Mountain, notably the stations of the groups of No. 33, No 34, No. 35 corps along the downstream area of Tarim Basin, Aral Oasis in the downstream area of Aksu River, Mosuowa Oasis in the downstream area of Manas River in southern Junggar Basin as well as Chepaizi Oasis in the downstream area of Kuytun River. The main aim of land development in this period was to promote the agricultural production. As a result, more than 3 million ha of cultivable land were newly developed in this period.

During period of "Cultural Revolution", the pattern of land development in Xinjiang transformed from large-scale development to scattered pieces of Oasis development. Some new Oases were

developed every year, while some existent ones were abandoned at the same time. Since 1977, Oases development in Xinjiang has been focusing on increasing the yield or meliorating the medium/low-yielding land.

4. Environmental Impacts of Oasis Land Use

The deterioration of oasis environment in Xinjiang is a process of changes in regional landscape and the great loss of bio-diversity, that resulted both from human activities and natural factors. As we knew, the natural conditions of oases are endogenously very fragile. But the human irrational economic activities in the past decades, such as rapid growth of population, over-development of cultivable land, exceeded the capability of oasis ecological system. In the newly formed desert, 85% is caused by the irrational development and misuse of water resource (Song, 2001). After decades of years' efforts, although the environment in the oasis has been improved in some respects, but aridity, sand storm and salinization are still threats, and continually decrease the oasis areas. Additionally, deforestation, deterioration of grassland, and excessive use of water resource are also increasingly severe.

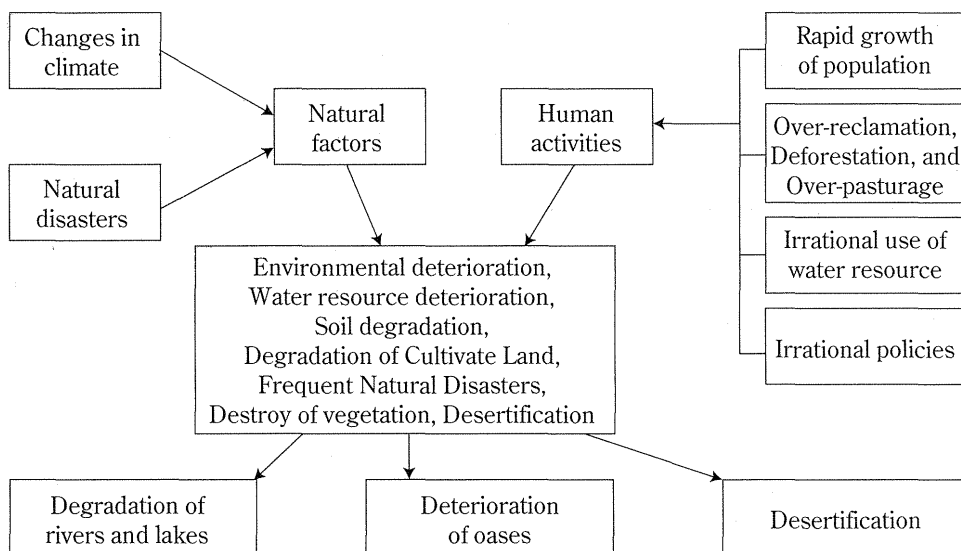


Figure 1 The Changes of Oasis Ecological Environment and Its Reasons

4.1 Deterioration of Water Resource

Water resource deterioration was often represented by the continually curtail of rivers, dry-up or withering of lakes, increase of river sand, as well as increase of the mineral content in water. Large-

scale reclamations of wasteland in the upper stream areas need a huge amount of water, leading to the reduction of water supply in the downstream, so as to curtail the river flow. Some rivers have appeared to dry up in the downstream. For instance, Tarim River has been broken out at Daxihaizi Reservoir since 1972 and the river was shortened by 320 kilometers. In the later 1980s, the total area of lakes in Xinjiang was 5505km², a 37.5% reduction compared with 8800 km² in 1950s (Zhang Jiabao, 1999).

To take out the salt in farmland, massive water was used for the farm drainage. However, the drainage water with salt will flow to rivers and lakes, then cause a continual increase of salty density. The Tarim River was ever regarded as a fresh-water one before 1958, with mineral content in the main stream lower than 1.0 g/L, while the annually average mineral density reached to so far as 1.34 g/L from 1985 to 1998. Bosten Lake has been losing its fresh water and has gradually been a weak-salt lake, and the organic pollution is especially severe.

4.2 Soil Degradation

Soil degradation was mainly caused by excessive use of land, lack of organic fertilizer, decrease of green manure crops such as alfalfa and leguminous, while maladjustment of irrigation and drainage would cause a secondary salinization. In the period from 1966 to 1988, soil nutrient had greatly decreased, respectively by 52.4% of Nitrogen, 16.3% of Phosphate and 10.2% of Kalium. Areas of medium/low yield have increased largely, sharing 89% of total farming land. The area of salinized soil reaches 84.8 thousand km², among which 18% are heavily salinized, 33% are medium salinized and 49% are slightly salinized. The amount of chemical fertilizer input has increased 15.48 times in 2001 compared with 1975. In the period from 1993 to 2001, the chemical fertilizer input of per unit area increased 151%, while the input of chemical fertilizer in Southern Xinjiang are specially high, respectively by 33% in Nitrogen, 46% in Phosphate and 42% in Kalium more than other places of Xinjiang.

Table 2 Fertilization by Per Unit Area (2001) (kg)

	Cultivated Area (ha)	Nitrogenous fertilizer		Phosphate fertilizer		Kalium fertilizer	
		Total	Per	Total	Per ha	Total	Per ha
The whole Xinjiang	3439320	954437	277.5	568891	165.4	59169	17.2
Local Amount	2366560	627988	256.4	402261	170.0	38604	16.3
North Xinjiang	1161240	226256	194.8	115910	99.8	11035	9.5
East Xinjiang	88620	19659	221.8	9020	101.8	1500	16.9
South Xinjiang	1116700	382073	342.1	277331	248.3	26069	23.3
The Corps	1072760	326449	304.3	166630	155.3	20565	19.2

Resource: 2001 Statistical Yearbook of Xinjiang Uyghur Autonomous Region.

4.3 Frequent Natural Disasters

Xinjiang is a area, where various natural disasters frequently happen, such as earthquakes, floods, drought damage, plant diseases and insect pests, squalls, hailstones, mud-rock flows, landslide, snow damage, desertification and salinization. In 1990-1996, ratio of disaster frequency of Xinjiang reached 65.6%, 15.3% higher than China's average level, though its rate of agricultural damage was slightly lower than late. The annual times of squall disasters occurred in Xinjiang were 16 in 1950s, and then increased to 105 in 1980s; while in the same period, the disaster of floods increased from 67 times to 235 times, snow calamities from 24 times to 93 times, hailstones from 4 times to 28 times. The total crop failure caused by the squall flood yearly was no less than 100 thousand ha. 53 of the 86 counties/cities within Xinjiang and 88 of the military corps' 174 farms were demolished by sandy storms. The living standard of more than 20 counties of Xinjiang is still under the poverty line, mostly accounting for the sand devil and drought.

4.4 Loss of Biodiversity

Forestry Mountainous forest area has been decreased by 20% for the past few decades, of which more than 30% were severely deteriorated. Desert bottomland forest (*populus diversifolia*) decreased by 60% while desert shrub forest (*haloxylon ammondendron* and *Tamarix* spp) by 20%. The decrease of forest in the downstream area of Tarim river was even more severe, with a 70% reduction of *populus diversifolia* from 54 thousand ha to 16 thousand ha, and 65-90% reduction of tamarisk spinney until 1992. By the sharp decrease of forests, the famous "Green Corridor" will be disappeared.

Grassland and Wetland The continuing decrease and deterioration of grassland and its' output of grass have caused severe conflicts between grassland protection and development of livestock industry. 80% of Xinjiang's grasslands are deteriorated in a variety of degrees, as well as the grass output dropped by 35.4-75.8%. Excluding the area around Tianshan Mountain, where there is not obvious deterioration, the total grassland of 688 thousand ha in Xinjiang is decreasing at a speed of 137 thousand ha per year. The marshland in the mainstream of Tarim River was reduced from 55.2 thousand ha in 1980s to 29 thousand ha in 1990s, while the total marshland in Xinjiang has dropped from 2.8 million ha to 1.48 million ha in the same period.

Wild lives Since 1985, the incidents of killing wild animals have been frequently and increasingly occurring in Xinjiang, with annual loss of 20 thousand wapiti, 30 thousand gazelle subgutturosa, thousands north goat, hundreds of argali and snow leopard, ten thousands of snow cock and numerous number of wild geese and ducks. Environmental deterioration has been leading to annihilation of rare wild lives. Three of China's ten species of annihilated animals disappeared in Xinjiang, namely, Przewalski horse, long nose antelope and Xinjiang tiger. Thus Xinjiang is facing severe environmental deterioration.

4.5 Desertification of Land.

Today, the "Sandy Storm" is one of China's severe disasters while Xinjiang occupies most of China's desert land. Taxorgan Desert, China's largest or the world's second largest is located in southern Xinjiang. Taxorgan Desert and Kurbantonggu Desert locate in north Xinjiang are regarded as China's two largest original places of sand devil. Xinjiang has 79.59 million ha of desertified area, accounting for 60% of China's total desertified area, while another 20 million ha, that occupied 12% of Xinjiang's territory, is mostly likely to be desertified. Furthermore, Xinjiang's desertification area is rapidly spreading at an annual speed of 40 thousand ha. Farming land suffering from sandy storms amounts to 666.7 thousand ha.

5. Causes of Oasis Environmental Deterioration

The oasis environmental deterioration in Xinjiang can be ascribed to natural factors and human improper activities. The natural factors have endogenously determined Xinjiang's ecological system has the features of low biomass, simple structure, instability, fragility and non-recoverable. In addition, human irrational use of land speeds up the deterioration process of oasis environment.

5.1 Natural and Social Factors

Population the total population of Xinjiang Region increased from 118 thousand in late 18th century to 278 thousand in the middle 19th century, to 4.333 million in 1949, and further to the current population of 18.762 million. In the past 51 years, Xinjiang's man-made oasis area has been expanded by 2.4 times while its population has grown by 3.22 times. Population growth exceeded the expansion speed of man-made oasis area. China's average farmland area decreased from 0.14 ha per head in 1965 to 0.098 ha per head in 2002 while Xinjiang dropped from 0.4 ha to 0.18 ha during the same period. Thus, the reduction speed of farmland per head in Xinjiang is faster than that of China's average level. Population pressure in oasis area is increasingly intensified. Then human activities can not avoid becoming an important factor to make the environment deteriorate.

Poverty Social poverty is counted for another factor ascribing to the environmental deterioration. Xinjiang has a poverty population of more than 500 thousand, whose survivals are merely dependent on excessive denudation of forest, farmland and grassland as well. Some inhabitants lop firewood from the desolate and boundless forests. Others excessively exploit glycyrrhiza, only leading to making the fragile desert environment unrecoverable and threatening the natural desolate forests and man-made oases. Environmental deterioration, in turn, sharply dropped the land productivity and led to much poorer living standard of the local inhabitants. Moreover, as restricted by the limited input in environmental protection, a vicious circle of "poor -environmental deterioration-poorer" is most likely to come into being.

Natural Conditions Far away from seas and relatively isolated from outside world, Xinjiang is scarcely effected by the hydrosphere flowing from the Pacific Ocean, the Atlantic Ocean and the Arctic

Ocean. The annual precipitation in the plain areas of Xinjiang is only 40-60 mm in the south and 150-250 mm in the north. Xinjiang, one sixth of China's total land area, shares only 4% of the country's total precipitation. In the view of water supply by per unit area, Xinjiang has 48 thousand m³/km, counted for the least three ones among China's all provinces. The shortage of water resource and dry climate have restrained Xinjiang's further development of land use though it has plenty of land resource. Natural conditions such as globally warming-up and continual-drought, again, lead to the failure of newly made forest while plant diseases and insect pests also can accelerate forest degradation.

5.2 Problems of Institutions

Due to lack of conscience of environmental protection and weakness of monitor mechanism, we failed in full awareness of protecting and recovering environment. Hence, the local leaders pay much more attention on economic growth rather than environmental issues. Economic development mainly relies on traditional growth pattern and on resource-oriented fields. Agricultural producers in the upper stream areas hold the advantageous positions and excessively use water resource, leading to water shortage and deterioration of environment in the downstream areas. Generally, some improvement is likely to be seen in the environment within oasis while the exterior part tends to be further deteriorated, and the overall environmental of Xinjiang is under deterioration.

Distorted policies From 1950 to 1970, policy-makers focused on solving foodstuff issues and encouraged massive reclamation of desolated area with little consideration on environmental issues. Since 1978, under the reform and opening up policies, producers and other individuals have been aiming at maximization of personal utilities. Though there are some changes in the institutional conditions, food production is still the first, followed by infrastructure construction and the last is environmental protection. Achievement of government leaders is evaluated by measuring the yield and total output of agricultural products. For the improper policymaking, development activities exceed the limit of natural environment, leading to the deterioration of regional ecology. Land development is totally inefficient, mostly depending on expanding area. From the agricultural history between 1949 and 1996, 28 years can be seen that the yields were less than 1500 kg/ha, 9 years between 1500 kg/ha and 3000 kg/ha and another 9 years between 3000 kg/ha and 4500 kg/ha. While in 1996 the yield reached 4962 kg/ha. However, by calculating the total areas of farmland, the yield is not more than 3750 kg/ha.

Mismanagement Policies of land use and development emphasize on reclaiming wasteland and enlarging farming land areas, putting aside protection and improvement of environmental qualities. The China's Land Law has no detail regulations on environmental protection. The third chapter of this law only emphasizes on the use and protection of the farmland rather than the total use. As the article 17 says: *Exploiting the state-owned barren mountains, wasteland and tidal-flat area for agricultural, forestry, pasture and fishery production by the development entities should be approved and confirmed by the local government but no lower than the level of county government.* The local government is encouraged to intensify the development of desolated areas for local economic growth. "Land use must accord to the overall development plan of rivers and lakes". Economic

growth pattern focusing on land development is most likely to be exploited in those areas where there are no overall development plans, inevitably leading to excessive reclamation of wasteland and environmental deterioration. Inefficient administration systems lead to improper management and irrational allocation of the limited water resource. For the lag of land management system, the local departments of land management affected by the short-run economic goal are very difficult in handling with illegal approval of land use.

Weakness of Plan An overall plan of land use always aiming at the dynamic balance of farmland, but ignoring the environmental protection, can be seen as a plan of land protection. Due to sluggish management of land use and incomplete system of programs, abuse land use and disputes on land distribution occurred frequently which represents that the Land Law has little authority, although China's Land Law and other relative regulations request overall programs and annual plans of land use,

Insufficient Input Of Xinjiang's total input of infrastructure construction, agricultural sector shared, respectively, 8.9% in the 6th Five-year Plan, 7.8% in the 7th Five-year Plan and distinctly decreased to 3.6% in the 8th Five-year Plan. Input in environmental protection is far less than the input in infrastructure.

5.3 Human Factors

An overall programming of oasis land is essential to protect oasis ecology, natural environment and the survival of wild species. The deterioration of environment, and extinction of wild lives are often derived from excessive exploitation and inefficient use of resources. Disappearance of Loulan Culture was a bitter example of aftermath of human excessive exploitation of natural resources (Zhao Qiang, 1998).

Excessive Reclamation With the continual growth of local population, the area of wasteland reclamation has been largely expanded, accounting for 322% compared with that of 1949. The 1988-1996 period witnessed 423 thousand ha of newly reclaimed area, in which 30% was illegally or individually developed. For the past 20 years, some new wasteland was reclaimed every year while, at the same time, some existent farmland was abandoned. The area of abandoned land counteracted the area of newly reclaimed land. Unplanned reclamation destroyed the existent vegetation and further weakened the protection of the earth's surface, leading to unbalance of the oasis environment and expansion of desert areas. All these brought about turbulence of the circle of oasis environmental system, destruction of biodiversity, and acceleration of desertification, salinization and soil erosion as well. For instance, over the past 50 years, the cultivated land area of Tarim Basin increased 92.9%, among which upper and medium stream areas increased by 73.3% and downstream area with 469%. Therefore, it is clear that excessive reclamation is counted for the major factor of the environmental deterioration of Tarim Basin.

Table 3 Changes in Cultivated Land Area of Tarim Basin (10,000 ha)

Region	1949	1955	1978	1980	1985	1990	1995	1998	2002
The total region	70.64	92.28	132.03	130.99	122.89	120.80	124.53	136.25	137.87
Ba Prefecture	3.48	7.41	15.76	15.63	15.28	15.81	16.82	19.83	21.84
Aksu	22.64	28.87	43.09	42.92	45.51	40.12	42.76	47.26	47.68
Ke Prefecture	2.53	3.23	5.46	4.79	4.22	4.12	4.04	4.13	3.49
Kashi	29.38	37.89	48.09	48.53	45.46	44.68	44.78	47.22	47.17
Hotan	12.61	14.88	19.63	19.12	16.42	16.07	16.13	17.81	17.69

Resource: *Xinjiang Statistical Yearbook*; *Statistical yearbook of Xinjiang Production and Construction Corps*

Excessive Reclamation of Pastures Irrational use of grassland and excessive depasture caused a series of issues such as degradation of regeneration capacity of grassland, decrease of grass output, and deterioration of grassland environment. Over the past 50 years, the heads of sheep increased by 10 times, counted as the first place among China's 5 northwest provinces. Excessive depasture on desert vegetation and over-reclamation of grassland caused severe deterioration of oasis-desert ecotone. The deserted area caused by excessive depasture accounted for 28.3% of the total deserted area of Xinjiang (Zhu Zhenda, 1989).

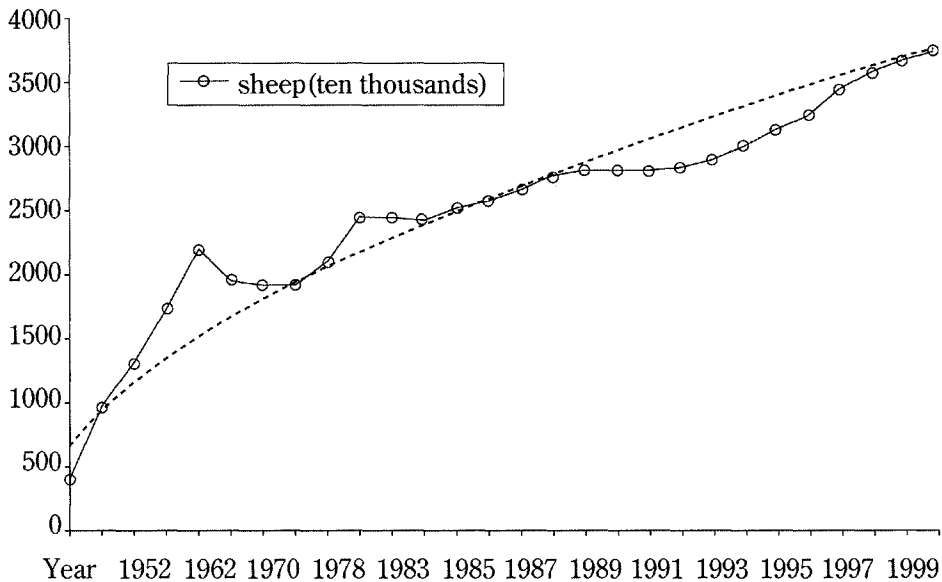


Figure 2 Changes in Sheep, 1949-2001

Resource: *Xinjiang Statistical Yearbook*.

Excessive deforest Forest resource is essential to forest environment and also is a natural protector of oasis environment. Destruction and decrease of forest resources directly effected the changes in forest environment. Xinjiang has forest area of 1.516 million ha, and a forest coverage rate of 1.14%, far less than the whole country's average forest coverage level 12%. Excessive deforests for reclamation and the breakout of river are looked as the most prominent factors of the decrease of forest and expansion of deserted area. The speed of desertification is surely overpasses the pace of human's afforestation and construction of protective forest belt in Sanbei Areas. Moreover, exploitation of vegetable resources also led to the devastation of some plants such as glycyrrhiza and ephedra, with strong capacity of environmental protection. The desertificated area caused by excessive exploitation of forest resource amounts to 31.8% of the total deserted areas (Zhu Zhenda, 1989)

Irrational Use of Water Resource The runoff in the Main stream of Tarim was 6 billion m³ in 1930s/40s and then dropped to 4.3 billion m³ in 1990s with annual reduction of 300 million m³. Poor management and disordered irrigation system led to large depletion of the river's runoff while irrigation index only reaches 0.32-0.46%. The total amount of irrigating water is over 1000 m³ per mu. Many reservoirs in plain areas caused water loss amounting to 2 billion m³ per year in evaporation and leakage. Excessive irrigation frequently resulted in secondary salinization and marshland of the farmland. Irrational use of water resource is increasingly becoming the major factor for the fragility of oasis environment. The desertificated area accounting for irrational use of water resource reached 8.3% of the total deserted area, as Professor Zhu Zhenda pointed (1989).

Conflicts of Water Resource Allocation the shortage of water resource caused the conflict between agricultural irrigation and ecological use of water while human's needs for production activities are considered prior to natural need of water. The current population and irrigation area of Tarim Basin respectively increased by 1.5 times and 1.8 times compared with those of 50 years ago, while in the same period, irrigation use of water increased by twice. All those induced breakout of the downstream and deterioration of oasis environment, would result in the withering of the natural forest and afforested trees and instability of ecological system of the Basin.

6. Conclusion

As we pointed above, environmental protection is often overlooked in Xinjiang, where the ecological system is very fragile, which will result in disasters. The environmental capacity of the oases is very limited, accounting for the fragile, unstable and unrecoverable characters of the arid environment. Therefore we have to trade off between the extensive economic growth and the limited environmental capacity, between the population growth and the continual deterioration of the environment, between short-run interests and long-run interests, and between the emergency of land exploitation and unconsciousness of the environmental protection in our development in Xinjiang. In our future policy-making, first of all the poverty issue should be solved so as to thoroughly eliminate the action of short-run irrational development ignoring the environmental protection. Then the irrational use of the resource can be controlled. In addition, the construction and the recovery of the ecological system mainly depend on the natural rules, aided by human construction.

Environmental protection of Xinjiang Region is now increasingly paid attention with further

advancement of China's West Development Plan. Only after a series of protection measures have been implemented, could a bright sight of overall improvement of oasis environment be seen in Xinjiang region. These measures may include: control of producing process and terminal governance, combination of exploitation and management, and progressive coordination of development and management as well. Environmental governance should be focused on afforestation, protective forest belt of ecosystem, protection of desert vegetation, water-intensive irrigation technology and renewing system of farmland cultivation. The projects under construction include: the Controlling Project of the Main Stream of Tarim River, Anti-desertification Project of Tarim Basin and Junggar Basin, Ecological Protection Project of Aibi Lake Area, the Natural Forest Protection Project of the Whole Xinjiang Region, the Afforestation Project of the Whole Region, and the Overall Environmental Improvement Project of Urumqi City as well. However, Xinjiang still has a tough task in dealing with the environmental issues despite the central government's increasing input in ecological protection. Table 5 shows the policies and key projects of environmental protection.

Table 5 Policies and Key Projects of Environmental Protection

Types	Title of Projects	Organizer and Investor	Expiry or Scale	Contents
Policies	Afforestation and Grass Growing in State-owned Barren Mountains ⁽¹⁵⁾	Xinjiang People's Government	The whole region	50-year right of land use; exempt of land remise fee
Land Use Programming	Construction of Ecological Environment	Xinjiang Production and Construction Corps	174 units of Xinjiang Production and Construction Corps	Implementation
Projects of Environmental Protection	Road Protective Forest belt for Road in Tarim Desert ⁽¹⁶⁾	National Committee of Reform and Development; ChinaPetro	Investment of RMB220 million	436 km of protective forest belt within 3years
	The overall Environmental Protection of Tarim River	China's Central Government	Investment of RMB 10.7 billion in 2001/5	Water trans portation, protective forest belt, application and expansion of water-intensive irrigation system
	The fourth project of Sanbei Areaon Cultivation Substitution Afforestation and Grass Raising ⁽¹⁷⁾	Xinjiang People's Government	Investment of RMB 1.2 billion in 2003	
	Grassland Construction ⁽¹⁷⁾	Xinjiang People's Government	Investment of RMB 6.5 billion in 2003-10	57 000 ha of irrigating grassland; settlement of immigrants
	Protection of Environment and Water Resource in Pasturing Areas ⁽¹⁸⁾	China's Central Government	Investment of RMB 2 billion in 2003/10 by Ili Prefecture	186 000 ha of irrigating forage grass base
	Programming of Environmental Protection in Hotan ⁽¹⁹⁾	The State Council	Total investment of RMB 1.3 billion	65000 ha of afforestation; 183000 ha of hillsides-closed forest facilitation; 51000 ha of cultivation-substitution forest; 171000 ha of artificial grass raise
	Water-intensive Irrigation Project Sponsored by JICA ⁽²⁰⁾	JICA and the Ministry of Finance of China	Total investment of RMB 1.975 billion by33 counties of 9 prefectures	6-year construction period of Water-saving farmland with 10 years of grace period
	Applying Technology of Water-intensive Irrigation System ⁽²¹⁾	Xinjiang Production and Construction Corps	267 000 ha of farmland in 2001/5	Technologies of drip irrigation, tube irrigation and subway drip irrigation

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